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ANNUITY MARKETS IN CHILE: COMPETITION, REGULATION—AND MYOPIA?

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Abstract: We study annuity rates in Chile and relate them with industry competition, finding: a) that annuity insurance companies paying higher broker commissions paid *lower* annuity rates; and b) a structural break of the long-run elasticity of annuity rates to the risk-free rate in 2001. Moreover, this structural break coincided with the submission of a new draft pension law proposing greater transparency in annuity markets and a generalized drop in broker commissions. The high commissions charged in the 1990s were partly returned to annuitants as informal (and illegal) cash rebates. *Myopic* pensioners preferred cash rebates over present values. Thus, the legal threat caused the drop in broker commissions, reduced the illegal practice of cash rebates, increased competition via annuity rates, and raised the long-run elasticity to one.

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PREFACE

ANNUITY MARKETS IN CHILE: COMPETITION, REGULATION—AND MYOPIA?

Between 1993 and 2003 the long-term risk-free rate in Chile fell by 3.2 percentage points, while the cost of an annuity increased by less than 12.3 percent, implying a very low implicit elasticity. This article estimates the long-term elasticity of *annuity rates issued by life insurance companies* (defined as the internal rate of return on expected future annuity payments) to changes in the market risk-free rate. It also examines interactions between the annuity rates and broker commissions as two alternative instruments of competition and checks whether there were structural breaks related to key regulatory actions. These questions are of general interest because, in defined-contribution pension systems, many pensioners are expected to purchase annuities upon retirement, and elasticities significantly smaller than one could indicate lack of competition via annuity rates. This result would be troublesome in the context of a mandatory pension system, because it could reveal failures in the last link in the long pension chain.

We find several interesting results. First, the estimated long-run elasticity increases rapidly after 2001, and the hypothesis that it is statistically equal to one cannot be rejected after that period. Second, this structural change is significantly related to a generalized drop in broker commissions. Third, both facts coincide with the submission to Congress of a new draft pension law proposing the creation of an electronic market for pension annuities and the imposition of a cap on commissions. Fourth, we find evidence that annuity insurance companies that paid higher commissions also paid *lower* total annuity rates. It is likely that higher commissions allowed more room for brokers to provide informal (and illegal) cash rebates to pensioners. This, in the case of *myopic* pensioners, reduced competition via annuity rates and increased competition via advance cash payments, despite the lower total present value received by the pensioner. The overall evidence indicates that the threat caused by the draft law (which was only passed in 2004) caused a generalized drop in broker commissions, which reduced the scope for cash rebates, increased competition via annuity rates, and caused the elasticity to become statistically equal to one.

GLOSSARY

AR	Annuity rate
BC	Broker commissions
CRV	Annuity cost
IRR	Internal rate of return
LICO	Life insurance company
PRC20	20-year bond issued by the Central Bank of Chile
SAFP	Superintendencia de Administradoras de Fondos de Pensiones (Superintendency of Pension Fund Administrators)
SVS	Superintendencia de Valores y Seguros (Superintendency of Securities and Insurance)
TVA	*Tasa de venta ajustada* (commission-adjusted annuity rate)
TV	*Tasa de venta* (annuity rate)
UF	Unidad de Fomento (Unit of account of price-indexed contracts)

1. INTRODUCTION AND HYPOTHESES

Many countries have reformed their pension systems in a similar way to Chile's reform of 1981. This reform was intended to provide reasonable self-financed pensions upon retirement, freeing the state from onerous future liabilities, caused in part by insufficient individual voluntary saving for retirement. The Chilean reform implied the privatization of social security and the creation of a fully funded, privately managed pension system with individual (fully portable) savings accounts that can be used exclusively for retirement purposes.

At retirement, most individuals typically have two choices: to withdraw the accumulated funds over time following a certain rule *(programmed withdrawal)* or to buy an annuity, sold in Chile by closely regulated life insurance companies. Each choice carries different types of risk: a *longevity risk*, which only an annuity covers, and an *investment risk*, which either the pensioner or the insurance company assumes in full.[1]

Because many pensioners opt for annuities (more than 60 percent in the Chilean case),[2] we need to understand the incentives faced by annuity insurance companies in this context. In particular, we want to know whether and how changes in the local risk-free rate are transmitted to annuity rates. In this paper, we define the *annuity rate* (TV) as the internal rate of return on expected future annuity payments.[3]

This is a theoretically simple question, but since the answer depends on the extent of competition in the insurance industry and the variables used for such competition, it is not obvious from an empirical perspective. Indeed, figure 1.A shows the time trend of the estimated inflation-adjusted cost of an annuity for a 65-year-old pensioner with no beneficiaries and compares it to a 20-year central bank interest rate (PRC20).[4] For many years this was the longest maturity interest rate, and (as we will argue later) it adequately represents risk-free investment opportunities for the life (annuity) insurance companies (LICOs). The inverse relationship, as expected, is apparent. However, considering the starting and ending points, we observe that the PRC20 rate dropped from 7.2 to 4 percent. With an estimated Macaulay duration of about eight years for the annuity, its cost should have increased by more than 25.6 percent, but it did only so by 12.3 percent. A simple regression of the logarithm of the annuity cost on this interest rate level (with several lags) gives a total coefficient of –3.2, and relating changes in annuity costs to interest-rate changes yields a slope coefficient of –2.6. These coefficients are unexpectedly low. Figure 1.B offers a tautological explanation for these findings: annuity interest rates start below the

[1] Lump-sums are restricted in Chile. For a detailed description of the Chilean pension system see Superintendency of Pension Fund Administrators (2003). For a description of potential pension modalities, see Edwards and Valdés (1998). Variable annuities were introduced in Chile in 2004.

[2] See the website of the pension supervisor (SAFP): www.safp.cl. This number underestimates the effective proportion of retirees that choose annuities, since it includes disability and survivorship pensioners.

[3] These expected payments are based on the (outdated) RV85 mortality table. This implies an overestimation of the level of annuity rates but should not significantly affect their changes through time. However, see section Determinants of Annuity Costs, below.

[4] In the Data section below, we explain the sources. In every case we use "real" (inflation-adjusted) interest rates.

risk-free rates (with negative spreads) and end above it (positive spreads). Interpreting an annuity as a long-term (special) bond issued by a LICO, the reported spread behavior is puzzling.

Here we estimate the long-term elasticity of annuity rates to market risk-free interest rates and also examine the evolution of this parameter through time. In light of the preliminary evidence presented, we also look for structural changes.

We believe these questions are important for several reasons. First, the sensitivity of the annuity cost to changes in market interest rates should partly reflect the degree or form of competition within the industry. If competition takes place via annuity rates, they should fully reflect changes in interest rates. In fact, we expect a long-term elasticity close to one. This implies an interesting question because the preliminary evidence indicates sensitivity significantly smaller than one. Such result may be a matter of concern for the regulatory authorities because this is the last link in a mandatory defined-contribution pension system. On the other hand, the behavior of annuity rates indicates that a structural change may have occurred, and that the elasticity may have changed. The causes of such a change are interesting to study. Finally, from a normative perspective, this parameter is important for determining the kind of investment strategies that, to head off future pension risks, pension funds should follow as future pensioners approach retirement age.

We find a number of interesting results. First, there is indeed evidence of a structural break in the long-term elasticity of changes in annuity rates to changes in the risk-free rate. Until the first quarter of 2001, the elasticity is significantly smaller than one, and from that point on it becomes statistically equal to one. The parameter change coincides with a large generalized drop in broker commissions. There is a statistically significant correlation between the two facts. They also coincide with a discussion in Congress of a new draft pension law proposing the electronic auctioning of annuities and a cap on broker commissions. We also find evidence that the LICOs that paid *higher* broker commissions paid *lower* total (adjusted) annuity rates.[5] It is therefore likely that higher commissions allowed more room for brokers and annuitants to *liquefy* pensions (through informal cash payments to the pensioner by the broker). This, in the case of *myopic* pensioners (forced to save all their lives), reduced competition via annuity rates and increased competition via commissions and the associated advance cash payments, even though, in present value terms, the pensioner could be losing money (as evidenced by the lower total interest-rate cost paid by the LICO).

We use the term *myopia* in the sense of high subjective discount rates, which would explain both the need for mandatory savings and the preference for advance cash payments (which partly undo the lifetime mandatory savings). However, we cannot rule out broker abuse of uneducated consumers, resulting in situations where the annuitants got limited cash rebates and a large share of the high fees ended up in the brokers' pockets. So, in this

[5] *Adjusted* annuity rates (TVA) correspond to the internal rate of return of expected future payments, after deducting commissions from the premium paid by the annuitant, so they correspond to the effective interest-rate costs paid by the LICOs.

case we need to assume irrationality or lack of education to explain how high-commission annuities were sold in the first place, when pensioners get no associated extra benefits.

Since the reform, we can safely conclude annuitants today get a much better deal. The evidence is mostly consistent with the interpretation that a legal threat caused a generalized drop in commissions. This reduced the slack for pension dilution (or broker abuse), increased competition via annuity rates, and caused the elasticity to become indistinguishable from one.

2. DETERMINANTS OF ANNUITY COSTS

From the perspective of a LICO, the process begins when an agent (broker) contacts a potential pensioner and induces him/her to exchange the balance in the (mandatory) individual retirement account for an annuity. The agent, who may represent several different LICOs, gets a commission for this service (usually measured as a percentage of the initial down payment or premium). Figure 2 shows the non-adjusted and adjusted annuity rates (TV and TVA, respectively) and the corresponding spread due to commissions. A fraction of this commission may be returned to the pensioner as an informal advance cash payment or rebate, implying that the pension is "liquefied." This marketing practice was illegal, but was apparently common during the 1990s. These incentives are expected to exist if the pensioner, forced to save during his/her entire active life, cannot take a lump-sum and is given the opportunity to withdraw informally some of the money in advance. (Although commissions have fallen, there is no information regarding how the decrease has changed net of cash payouts to the pensioner.)

Evidently, this transaction generates a long-term liability for the LICO. From this perspective, the relevant interest rate is the commission-*adjusted interest rate* (*tasa de venta ajustada*, TVA). Regulations require that, in addition to the premium paid by the pensioner, equity holders in the LICO must put in new equity. This can be achieved in two ways. First, the maximum leverage ratio is 15. Second, there is a relatively strict norm, based on asset-liability cash-flow matching requirements, that the unmatched liability cash flows must be discounted at rates notably lower than market rates. This implies that the calculated present value of the liability is larger than the net premium received by the LICO, which is reflected as an immediate accounting loss in the equity value, meaning that shareholders must put up additional equity.

An important question is whether this additional equity requirement in itself is a direct cost that should be deducted from the interest rate paid to the annuity holders. If there is access to capital markets the answer is negative because if the new equity is invested in financial instruments traded in capital markets at fair prices, the transaction has zero net present value.

However, from the perspective of a LICO other costs are associated with a new annuity, which can be categorized as operating or administrative, financial and technical. Financial costs are associated with eventual mismatching of asset-liability cash flow (or duration); technical costs are related to mortality table risk and consist of systematic underestimation of life expectancy.

Regarding mortality table risk, by definition it is impossible for all pensioners to live more than the average life expectancy. However, mortality tables may be outdated, underestimating life expectancy. This means that the estimated (reported) annuity interest rates, calculated using these outdated mortality tables, will be biased downward.[6]

2.1 Modigliani-Miller and the Expected Elasticity

From the perspective of a pensioner, whether a home-made annuity is feasible is an important question. If the age at death is known with certainty, it is feasible using a ladder of risk-free bonds. If the pensioner cannot build the ladder, the LICO cannot provide one either without assuming risk. Recognizing the longevity risk, the pensioner should be willing to give up a fraction of his/her pension in exchange of longevity insurance. However, if longevity risk is largely diversifiable at no cost, in a competitive annuity industry the pensioners should not be charged for it.[7]

An annuity can be interpreted as a long-term bond guaranteed by a LICO. If annuities are priced (as corporate bonds are) in highly competitive and informationally efficient markets, the main determinants of their interest rates should be the long-term, default-free rates and LICO credit risk. General credit-risk results should also be directly applicable to this case. Applying Acharya and Carpenter's analysis of corporate defaultable bonds (2002), and assuming that long-term matching risk-free assets do exist, the price of an annuity A_t should be

$$A_t = B_t(1-c_t) \tag{1}$$

where B_t is the price of a matching default-free bond and c_t is the value of the default option held by the LICO equity holders, expressed as a fraction of the value of the default-free bond. It corresponds to the option of buying the risk-free bond with the LICO's assets, so the underlying asset is the riskless bond and the exercise price is the assets' value. The default option is valuable if the asset-liability ratio is "high", if there is significant mismatching and/or if assets are risky. However, it is important to note that, given an asset-liability ratio, investing in riskier assets (with higher interest rates or spreads) not necessarily implies that higher interest rates should be paid on annuities. Modigliani and Miller (1958) prove that equity absorbs the risks in the first place and that only when risk becomes "large" is it shared with debt holders.

In any case, determining whether the option to default is valuable is an empirical matter. Considering that debt-equity ratios have been much lower than their legal maximum (11 versus 15),[8] despite mismatching, that LICO portfolios tend to be conservative, and that risk-ratings have been in general above (local) AA, we conjecture that the default option is not significantly valuable.

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[6] For example, assume constant annual payments for 25 years and an interest rate of 4 percent. If we wrongly assume that the payments will take place only during 22 years, the reported interest rate will be 3.2 percent.

[7] Here we think of diversification at the LICO shareholders' level. We do not mean to say that longevity risk is diversifiable within each LICO.

[8] However, we need to keep in mind that these leverage ratios are calculated with outdated life-expectancy tables such that the true economic leverage may be larger.

To model the annuity elasticity with respect to changes in the risk-free interest rate, let A_t^* be the reported annuity cost, which underestimates the true annuity cost by $u_t = (A_t - A_t^*) / B_t$. We can rewrite equation (1) as

$$A_t^* = B_t(1 - c_t - u_t) \tag{1'}$$

Thus,

$$\frac{d\log A_t^*}{dy} = \frac{d\log B_t}{dy} - (1 - c_t - u_t)^{-1}\left[\frac{d\log c_t}{dy} + \frac{d\log u_t}{dy}\right] \tag{2}$$

where y is the long-term interest rate. Expressing this in terms of interest rates, we can write

$$\frac{dy^*}{dy} = \frac{D_{B_t}}{D_{A_t^*}} + \frac{1}{D_{A_t^*}(1 - c_t - u_t)}\left[\frac{d\log c_t}{dy} + \frac{d\log u_t}{dy}\right] \tag{2'}$$

or

$$\Delta y^* \approx \left[\frac{D_{B_t}}{D_{A_t^*}} + \frac{1}{D_{A_t^*}(1 - c_t - u_t)}\left[\frac{d\log c_t}{dy} + \frac{d\log u_t}{dy}\right]\right]\Delta y \tag{2''}$$

where y^* is the reported annuity rate and $D_\bullet$ are the corresponding modified durations.

Following Acharya and Carpenter (2002), an interesting implication of (1) is that when interest rates fall (increase), the value of the riskless reference bond increases (decreases), but the default option value (to purchase a more valuable underlying asset) also increases (decreases) ($d\log c_t / dy < 0$), assuming that the assets' value (the exercise price) increases by less. This is the case if the assets have lower duration or if they are riskier than liabilities. The implication of the measurement error is similar: when interest rates increase (decrease) the present value of the farther away cash flows falls (rises). Therefore, from (2'), if the option to default is valuable or if measurement error is significant, annuity interest rates should fall (increase) by less than the risk-free rates, and the elasticity may be lower than one, even if the reference bond and the annuity have the same durations. On the other hand, an elasticity equal to one should imply no significant default risk or significant mismeasurement, assuming efficient markets.

In any case, we may expect reported annuity interest rates to be lower than the risk-free rates, even if a small risk premium may have to be added to it, because (1) reported rates underestimate true annuity rates; (2) operational costs have to be subtracted from asset returns; and (3) eventual additional premiums, related to mismatching and mortality table risk, may have to be charged to the annuitant, if they cannot be diversified.

2.2 The Case of Chile

Since 1993, the Chilean fixed-income market has had 20-year inflation-indexed bonds issued by the central bank. Its Macaulay duration was about 8 (9) years at the beginning (end) of the sample period. Given the duration of an annuity, this instrument offers good asset-liability matching opportunities and is a useful reference point in the sense that it should be used to set the rates of the *marginal* annuities.[9]

With this in mind, the evidence presented in figure 1.B indicates an interesting evolution of the annuity-rate spreads (defined as the annuity rate minus the risk-free rate): they were negative by more than 1 percentage point at the beginning of the sample period and became positive toward the end. Between 1993 and 2003, we find an increase of 169 basis points in the average spreads (table 1.A). Measurement error arguments cannot explain this; only very significant increases in risk levels could.[10] However, even under this hypothesis, the negative initial spreads are hard to understand. Furthermore, the risk argument would contradict any unit elasticities that might exist. The explanation may therefore lie elsewhere.

3. THE DATA

In this section we describe the data that are used for the different estimations, its sources, and present a few descriptive statistics.

3.1 The Original Data

The original annuities data come from the Superintendencia de Valores y Seguros (SVS). SVS keeps records of annuity interest rates and also of average market commissions, which were reported annually until 1999 and quarterly after that. Average annual rates are presented in table 1.A. The adjusted annuity rates (TVA) represent the effective interest-rate cost for the LICOs. To estimate this cost, we must subtract the broker commission from the annuity premium and recalculate the internal rate of return with the new (lower) initial payment. For example, in the case of perpetuities, the cost is equivalent to dividing the interest rate by one minus the percent commission of the sales agent. To estimate the TVA, we assume that the average commission is constant throughout the corresponding reporting periods (annually at first and then quarterly). The same information is presented in figure 2, but in terms of annuity interest rates before and after commissions, and the corresponding spread. Table 1.B shows additional descriptive statistics. The reference interest rate (PRC20) was obtained from transactions data the last trading day of the month at the Santiago stock exchange (Bolsa de Comercio de Santiago).

3.2 Annuity Payment Profile

Figure 3 shows the payment profile for a 65-year-old pensioner with no beneficiaries, for a premium of 1,000 UF[11] and a real interest rate of about 5 percent per

[9] See Data section, Annuity Cost Behavior.

[10] For example, in the US for 10-year bullet bonds, such an increase would be associated with a drop in risk ratings from significantly above to significantly below investment grade. See for example www.bondsonline.com .

[11] The UF (Unidad de Fomento) is the indexed (inflation-adjusted) unit of account. It is calculated as follows: given an initial value expressed in pesos for the day 9 of a given month (say, Ch$17,000) the ending value of the UF for day 9 of the following month is calculated as Ch$17,000(1+$inf_{t-1}$), where inf_{t-1} is the inflation rate of the previous month. The quantity Ch$17,000($inf_{t-1}$)/$n$, where n is the number of days in a month, is successively added to the previous day's value of the UF.

year. Such a profile is obtained from the official mortality tables (RV85) used by the LICOs until 2003. Considering this payment profile and the annuity interest rates, we obtain estimated annuity costs.

3.3 Annuity Cost Behavior

With the adjusted annuity rates (TVA) and the profile just described, we estimated an index representative of the annuity cost (CRV). For descriptive purposes, it can be related to the TVA. Considering that interest rates changed significantly in the sample period, we estimated the durations in a slightly unconventional way, as a function of interest-rate levels, and by doing so we take into account that durations change with interest-rate levels. Notice that we do not assume an adjustment lag or anything of that sort. It is just an ad hoc definition. Table 2 shows empirical estimations of the annuities' modified duration and (marginal) convexity.

Given the relationship that (by definition) exists between the annuity cost and the TVA, the regression adjustment is almost perfect. The (empirical) modified duration (which measures the percentage change in the annuity cost given a 1 percent change in its interest rate) turns out to be $10–44TVA_{t-1}$. For example, for an adjusted interest rate of 4 percent, the modified duration is 8.24. The (empirical marginal) convexity (which accompanies the quadratic term) is 22. For comparison, we perform the same exercise for a PRC20 total return wealth index, which assumes monthly investment in a new PRC20. We get a modified duration of $9.72–32PRC20_{t-1}$. With 4 percent interest rates, the modified duration is 8.44. The empirical or residual convexity of this instrument is marginally larger than that of the annuity.

We can thus conclude that the PRC20 may be a reasonable instrument for matching LICO assets and liabilities, at least in the case of 65-year-old male. However, it is important to keep in mind that many of the annuities paid by insurance companies actually correspond to early retirees, and for that purpose the duration of the PRC20 is too short.

3.4 Causality Relations

As part of the descriptive information, it will prove useful to perform Granger causality tests. Considering the full sample and the interest-rate levels, several statistical criteria indicate an optimal lag of about 3 months. Considering changes in interest rates, the optimal lag is 2. Table 2.C shows the results. As expected, they indicate that PRC20 interest-rate levels and changes "cause" the levels and changes in annuity interest rates. The inverse relation does not exist, implying that annuity interest-rate levels and changes do not anticipate future interest rates. These results do not change much considering other sample periods.

4. METHODOLOGY AND RESULTS

Here we estimate the long-term elasticity of annuity interest rates to changes in the risk free rates, look for structural changes and present robustness checks.

4.1 Long-Term Elasticity

One purpose of this study is to determine the long-term elasticity of the annuity cost to the relevant long-term interest rate (equation [1']). This is equivalent to estimating the annuity interest-rate elasticity to the same variable (equation [2']). We use the second alternative, since the interpretation is clearer. Our hypothesis is that the elasticity is equal to one, which would be true if the chosen risk-free rate adequately represents the marginal cost of an annuity and if risk or mismeasurement considerations are unimportant.

Because some time must elapse between the sale of the annuity and the official recording and reporting of the sale, a lag is to be expected, particularly if we use month-end, risk-free interest rates. It may also take time for the LICOs to adjust their business strategies to changing market conditions. We thus estimate the following equation:

$$\Delta TVA_t = a + \rho \Delta TVA_{t-1} + b_0 \Delta PRC20_t + b_1 \Delta PRC20_{t-1} + \ldots + b_\tau \Delta PRC20_{t-\tau} + \omega_t \qquad (3)$$

With this specification, to have at least part of the changes in the risk-free interest rate transmitted to the annuity interest rate in the long term, we need $\sum_{l=0}^{\tau} b_l > 0$. In addition, to have unit elasticity, we require $\frac{1}{1-\rho}\sum_{l=0}^{\tau} b_l = 1$ or equivalently $\sum_{l=0}^{\tau} b_l = 1-\rho$.

Results are presented in table 3. We used two lags, given the results presented in the previous section. If we also include the contemporaneous market rate, the coefficient is essentially zero and does not affect the results. The sum of the coefficients b_1 and b_2 is 0.3; it is highly and significantly different from zero (table 3.B). The coefficient of the lagged dependent variable is 0.34522, which gives a long-term elasticity of 0.466, which is significantly smaller than 1 (table 3.B). Thus, the evidence so far contradicts the hypothesis that changes in the long-term interest rate are fully transmitted to the annuity cost.

4.2 Structural Changes

Given the observed evolution of the spreads between the annuity costs, of the risk-free interest rate and of the reported commissions (figures 1.B and 2.A) a reasonable doubt arises about whether long-term elasticity has changed. With this in mind, equation (1) was estimated with rolling 36-month samples. With each estimation, we verified the hypotheses $b_1 + b_2 = 0$ and $b_1 + b_2 = 1-\rho$ with likelihood ratio tests. Our results, shown in figure 4.A, are eloquent. The sum of the coefficients b_1 and b_2 is always significantly different from zero. Furthermore, after mid-2001 the long-term elasticity $(b_1 + b_2)/(1-\rho)$ becomes statistically indistinguishable from one. This means that evidence of a structural change is clear and that all of the market interest changes were fully transmitted to the annuity costs during the last three sample years.

4.3 Robustness Checks

Here we present robustness checks of our results, by considering alternative dependent (unadjusted annuity rates) and independent (term-structure-adjusted risk free rates) variables.

4.3.1 Unadjusted Annuity Rates

We repeated the rolling estimation exercise using the (unadjusted) annuity interest rate received by the pensioner. Results are presented in figure 4.B. They are essentially similar to those found using the adjusted interest rate or TVA. It even looks as if these unadjusted interest rates began their adjustment earlier.

4.3.2 Relevant Market Interest Rate

LICOs might consider a different interest rate as the relevant one for determining the annuity cost considering that the payment schedule of the PRC20 is flat and biannual, whereas expected annuity payments are monthly and decreasing.

To consider this possibility, we performed the following exercise. First, we estimated the end-of-month term structure of interest rates between 1993 and 2003 using bonds issued by the central bank of Chile, based on the Nelson and Siegel (1987) parametric representation. With the estimated term-structure parameters, we obtained a full set of monthly zero-coupon prices. Then, we used these prices to determine the monthly present value of the annuity and the corresponding series of internal rates of return.[12] Figure 5.A shows the evolution of the estimated annuity cost and Figure 5.B its internal rate of return (IRR). The regression R^2 of running the IRR against the PRC20 rate is 0.99, and the slope coefficient is insignificantly different from one with a p-value of 15 percent. Thus, for the purposes of this study, no term-structure-related errors seem to affect the results.

5. INTERPRETATION

Summarizing, so far we have documented the following facts: first, at market interest rates the annuity costs increased by 30 percent, whereas the total price charged to pensioners increased only by 12 percent. This happened because spreads between the adjusted annuities interest rates and the reference rates (PRC20) were negative at the beginning of the sample period and became positive toward its end (figure 1.B).[13] Second, reported commissions have dropped (table 1 and figure 2). Third, the annuity interest-rate elasticity to market interest rates was significantly smaller than one and turned statistically indistinguishable from one. Thus, we should see what changes in the industry might explain these noteworthy adjustments in the annuity parameters.

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[12] Calculation details are available from the author upon request.

[13] Given the reasoning presented in the previous sections, it is hard to understand why annuity rates end above the risk-free rates, especially if they are underestimated in outdated mortality tables. It is as if competition may have taken annuity rates "too far." The evidence analyzed in James, Song, and Vittas (2001) is consistent with the idea that annuity rates in Chile are "too high" toward the end of the sample period. There are several possible explanations for this: (1) risk is much higher than what we assume it to be; (2)) irrationality (or agency problems) influence LICO behavior; (3) there are generalized (market-timing) bets on interest-rate increases (which itself may be rational or irrational, depending on the efficiency of the local financial market); (4) some LICOs may also be assuming conscious losses in order to acquire dominant market shares. This needs further study. However, even if, from the LICO's perspective, annuities are sold with negative net present value, this need not imply bankruptcy or be reflected as negative margins in the financial statements.

The drop in commissions coincides with the date the elasticity became statistically equal to one, and both changes coincide with a generalized drop in interest rates. Jointly, these facts probably indicate that these changes reflect intensified competition via interest rates in the annuity industry. The very fact that commissions fell is likely to indicate more competition. We now analyze the evidence further to check this conjecture.

5.1 Commission Levels

A potential indicator of the degree of competition is the commission level. It may be argued that if part of these commissions is returned to pensioners it may be a bad indicator. However, in view of the generalized drop in interest rates, it is likely that LICOs may have to compete more actively through annuity rates. To verify this, we regressed the (log of) the long-term elasticity reported in figure 4.A against commissions, measured as interest-rate spreads (figure 2). We also included the interest-rate level as an additional regressor to see whether the drop in interest rates alone explained the structural change. Results, presented in table 4, confirm the latter conjecture. The effect of interest rates on the long-term elasticity is not significant, but the level of commissions is.[14]

5.2 Commissions and Adjusted Annuity Interest Rates

Whether the pensioner ends up with a worse deal (lower net present value) with an advance cash payment when the commission is increased is also of interest.[15] One way to check this is to verify whether LICOs that paid higher commissions (partly returned to the annuity buyer) obtained cheaper financing, by paying a lower total interest-rate cost on their annuities. To study this, we need detailed information at the LICO level, which has been available since 2001.

We performed the following exercise. First, we estimated the adjusted interest rates (TVA) using LICO-level annuity interest rates (TV) and broker commissions (C), controlling for market share (p), for each month and for each LICO, considering a 65-year-old pensioner with no descendants. Using a panel data specification we estimated the following:

$$TVA_{it} - PRC20_{it-2} = c_{o(i)} + c_1 p_{it} + c_2 (TVA_{it} - TV_{it}) + e_{it} \tag{4}$$

and

$$TVA_{it} - PRC20_{it-2} = c_{o(i)} + c_1 p_{it} + c_2 C_{it} + u_{it} \tag{5}$$

Market share was used as an additional control variable, to consider the possibility of systematic differences. In any case, given eventual endogeneity problems, we also estimated the equations using lagged market shares and excluding this variable altogether. Results do not change much.

We used several panel data specifications (common constant for all panel members, lagged dependent variable, fixed effects, and random effects). Results are presented in table

[14] We tried with one interest rate and several different lags (one at a time due to multicolinearity), and the results did not change significantly.

[15] See footnote 6.

5. Part A shows the results of estimating (4) and part B, of (5). Results are quite consistent with each other, and in this sense they seem robust. In every case, we verify the hypothesis that *higher* commissions are associated with *lower* adjusted interest rates. Depending on the specification, an additional percentage point in commissions is related to a lower interest-rate cost between 9 and 18 basis points.[16]

To further understand the importance of this result, assume for example that the annuitant pays 1, 1-c is received by the LICO and c by the broker. To simplify, let us work with perpetuities and assume that they are a function of this commission, A(c). We find that that the adjusted annuity rate R(c)=A(c)/(1-c) decreases with c (dR(c)/dc<0). Differentiating we find

$$\frac{dR(c)}{dc} \equiv \frac{1}{1-c}\left[\frac{dA(c)}{dc} + \frac{A(c)}{1-c}\right] = \frac{1}{1-c}\left[\frac{dA(c)}{dc} + R(c)\right] < 0 \qquad (6)$$

implying that

$$dA(c) < -R(c)dc \qquad (7)$$

Therefore, even if annuitants get all of the higher commissions back as rebates, it is actuarially unfair, since the annuity falls by more than the interest rate times the additional commission. In other words, from the perspective of the pensioner, higher commissions definitely are associated with lower net present values.

5.3 Changes through Time

Considering the possibility that our results are driven only by the significant drop in commissions, we reestimated (2) in successive rolling quarters. Because these are essentially cross-sectional regressions, we did not subtract the PRC20 interest rate, and we used a common constant. Results are presented in figure 5, together with the LICO-level commissions. We do find that the significantly negative relationship between commissions and adjusted annuity rates exists only until mid-2001 and then disappears.

5.4 Other Evidence

Additional evidence is consistent with the idea that the reported structural changes are due to changes in competition levels or attributes. Indeed, in November 28 of 2000 begins the official Senate discussion of a new draft pensions law to implement a mandatory system of electronic annuity auctions, which would also impose a cap on commissions. Among other things, this new law would have established that "(pension fund) affiliates may select one of the three best pension offers or any other offer which is at least equal to the average of the top three [annuity rates] minus 2 percent", which would indirectly limit the maximum pension dilution. In addition, it "forbids insurance companies, brokers, sales agents and other people intervening in the process of selling annuities to offer incentives or benefits other than those established in the law, with the purpose of contracting pensions using this modality".[17]

[16] For the specification with the lagged dependent variable, we divided the commission coefficient (–0.0304) by one minus the average coefficient on the lagged dependent variable.

[17] See Diario de sesiones del senado, publicación oficial legislatura 343ª. See references.

The commission levels (figures 2 and 5) had already dropped in the first quarter of 2001. Thus, it seems likely that the industry used the reduction as a “self-regulation signal” (or first move) to influence the legislative debate.[18] Because this legal change also meant changes in competition mechanisms, the reduction may have been an attempt to accelerate sales. An indirect indicator of this probability is the cross-sectional dispersion in monthly market shares, which peaked first in 2001 (and then more permanently in 2003, indicating a more permanent market concentration).

6. SUMMARY AND CONCLUSIONS

The objective of this paper has been to estimate the long-term elasticity of annuity interest rates to changes in market interest rates, but this investigation disclosed several other interesting facts. We believe this is an important question in the first place because this elasticity partly reflects the degree of competition or the attributes used to compete in the annuities industry.[19]

From a public policy perspective, it would be worrisome to find that annuity rates do not reflect financial market conditions. That would mean that, after a long accumulation phase in the mandatory pension system, pensioners at the beginning of the payout phase would leave a significant portion of their lifetime savings in the hands of brokers and annuity insurance companies in the form of “excessive profits” (reflected in cheap financing costs). This absurdity might be due to myopia (“the original sin”) on the part of the pensioners, accepting advance cash payments in exchange for actuarially unfavorable annuity payments.

This study indicates that, between 1993 and 2003, annuity costs measured by market interest rates increased by 30 percent, while the actual cost charged to pensioners by LICOs increased only by 12 percent. This happened because annuity interest-rate spreads with respect to the risk-free rate (PRC20) were negative at the beginning of the sample period and turned positive at the end of it.

Results also indicate that annuities have always been sensitive to market interest rates, but until 2000 only a small fraction of interest-rate changes was transmitted to annuity interest rates (with a long-term elasticity between 20 and 40 percent). From that point on, we cannot reject the hypothesis of a unitary elasticity, which means that changes in market rates are fully reflected in annuity interest rates. This structural change is significantly related to a generalized drop in broker commissions. The higher elasticity and the lower costs coincided with the discussion in Congress of a draft law that would have forced an electronic auction of annuities and imposed a cap on commissions. In addition, we find evidence that companies that paid higher commissions also paid lower total (adjusted) interest-rate costs on annuities.

[18]The softer version of this law approved in 2004, indeed imposed a cap on fees, and created a fairly transparent information system of annuity quotations for potential pensioners, but without the obligation of choosing among the top three. See references.

[19] This elasticity is also important for determining the investment policies that that pension funds should follow to immunize pensions (Walker 2003).

An explanation that is consistent with all the combined evidence is that higher commissions allow more room to liquefy pensions (advance cash payments or rebates to the pensioner by the broker), which in the case of myopic pensioners reduces competition via pensions and increases it via advance cash payments, even though the total net present value received by the pensioner is lower. In summary, our results are consistent with the interpretation that the legal threat caused a generalized drop in broker commissions, reducing the slack for pension dilution, increasing competition via annuity rates, and causing the elasticity to increase and become equal to one.

There are two competing explanations, coming from very different angles. First, we cannot rule out that annuitants got modest cash rebates and that a large part of the higher fees just ended up in the broker’s hands—broker abuse of uneducated consumers. This story uses irrationality or lack of education to explain how high-commission annuities were sold in the first place, when pensioners got no compensatory extra benefits. In this case, we can conclude that today’s annuitants almost certainly get much better deals.

Another possible explanation is risk: that spreads increase due to higher credit risk of life insurance companies. There may be some truth to this, since a generalized drop in interest rates significantly increases LICO debt and debt-to-equity ratios, if assets and liabilities have been mismatched. However, this explanation is hard to reconcile with the initial negative spreads and with the fact that since 2001 the long-term annuity rate elasticity to changes in the risk-free rate has become equal to one, something that should happen only if risk is relatively low. Risk can neither explain why life insurance companies that paid higher commissions also paid lower adjusted annuity rates. We thus believe the evidence is more consistent with our interpretation of myopic incentives.

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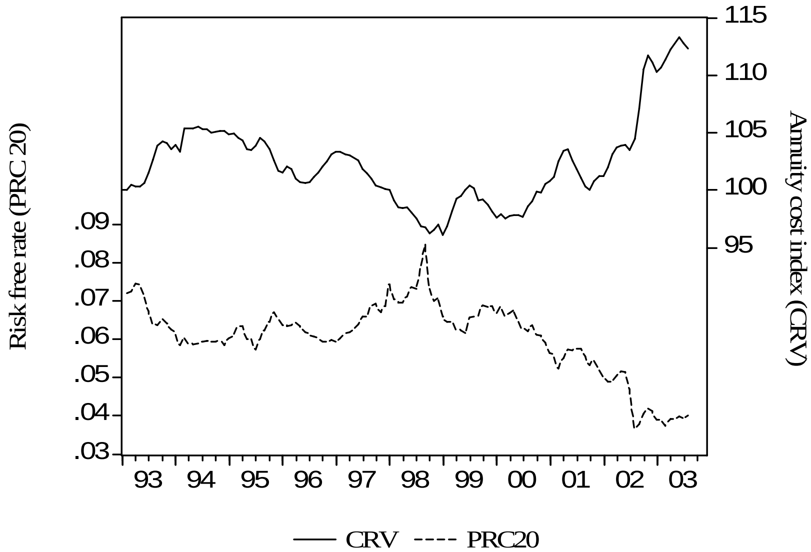
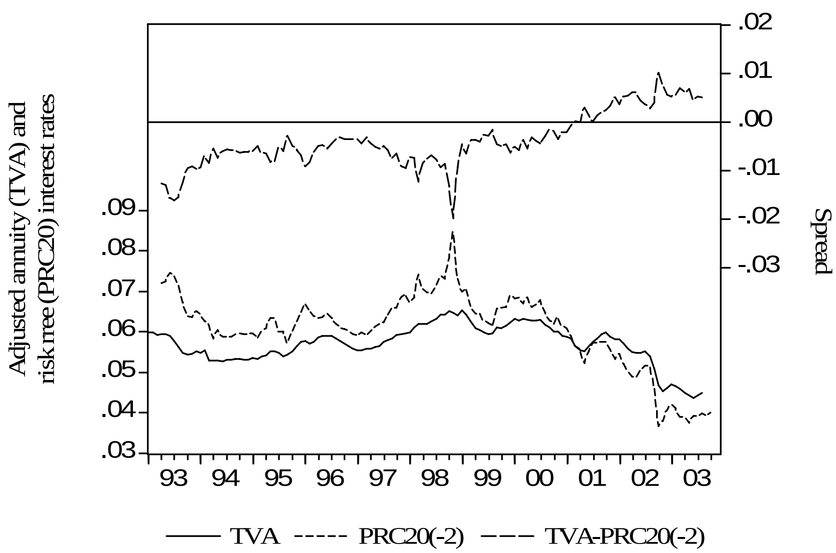
Figure 1: Annuity Costs, Market Rates, and Interest Rates

A. Annuity Costs and Market Rates



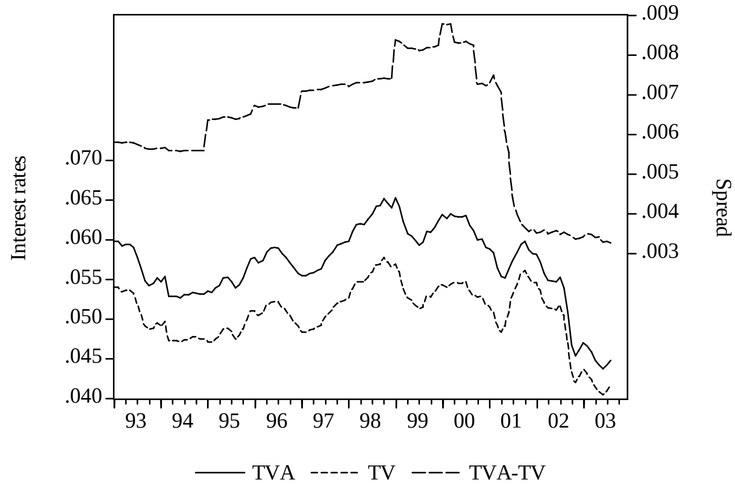
Note: The annuity cost index (CRV) is calculated as the scaled present value of expected future payments, using the RV85 mortality table for a 65-year-old male pensioner with no beneficiaries, and "adjusted" annuity rates (TVA). Adjusted rates correspond to the effective internal rate of return paid by life insurance companies, which excludes from the premium paid by the annuitant the commissions paid to the brokers. PRC20 corresponds to the Central Bank long-term indexed bond interest rate.

B. Interest Rates



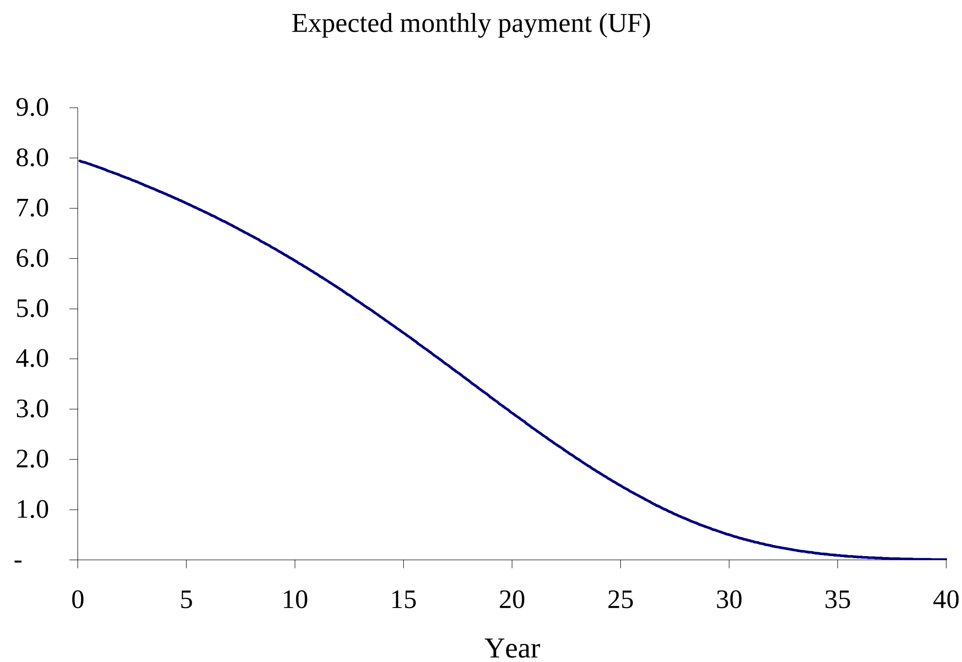
Note: TVA corresponds to the "adjusted" annuity rate using the RV85 mortality table for a 65-year-old male pensioner with no beneficiaries. Adjusted rates correspond to the effective internal rate of return paid by life insurance companies, which excludes from the premium paid by the annuitant the commissions paid to the brokers. PRC20 corresponds to the Central Bank long-term indexed interest rate.

<u>Figure 2: Annuity Rates (TV) and Adjusted Annuity Rates (TVA)</u>



Note: *TVA corresponds to the effective internal rate of return paid by insurance companies, which excludes from the premium paid by the annuitant the commissions paid to the brokers. TV is the effective interest rate (IRR) obtained by the annuitant, calculated using the total premium paid and the expected future payments received. In all cases, we use the RV85 mortality table for a 65-year-old male pensioner with no beneficiaries.*

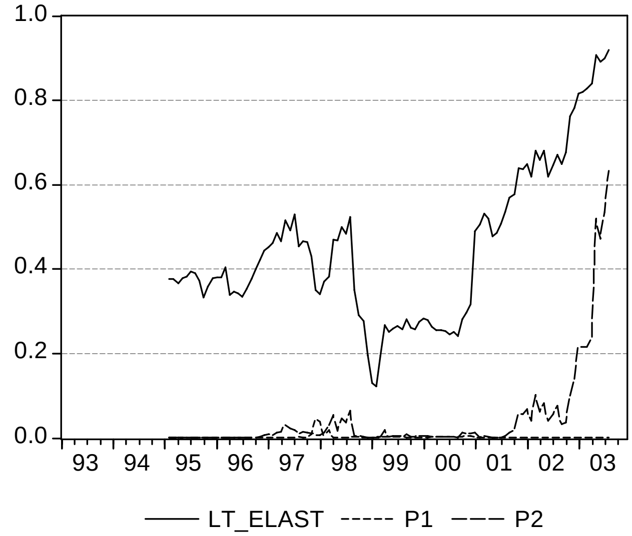
Figure 3: Annuity Payment Profile



Note: The profile is for a male, age 65, no descendants, premium of 1000 UF (see footnote 10), market rate 5.07 percent, using the RV85 mortality table.

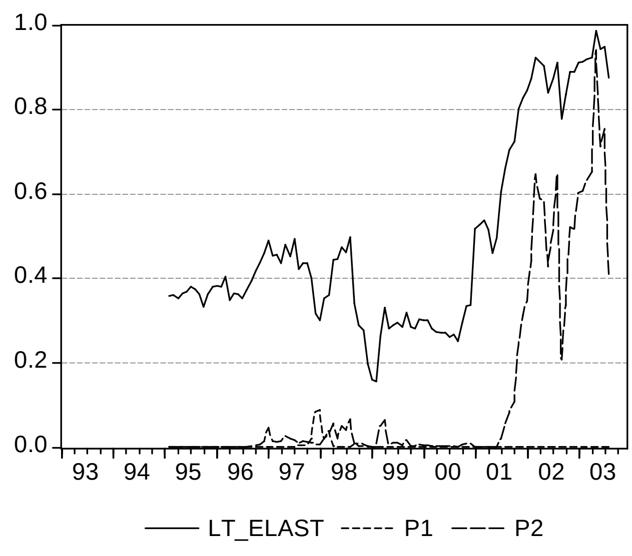
Figure 4: Estimated Elasticity of Adjusted and Unadjusted Annuity Rates to Changes in the Reference Risk-free Rate

A. Adjusted Annuity Rates (TVA)



Note: *Estimated equation:* $\Delta TVA_t = a + \rho \Delta TVA_{t-1} + b_1 \Delta PRC20_{t-1} + b_2 \Delta PRC20_{t-2} + \omega_t$. *The figure shows rolling estimations of* $(b_1 + b_2)/(1-\rho)$ *(LT_ELAST), p-values of the restriction* $(b_1 + b_2) = 0$ *(P1) and of the restriction* $(b_1 + b_2) = (1-\rho)$ *(P2)*

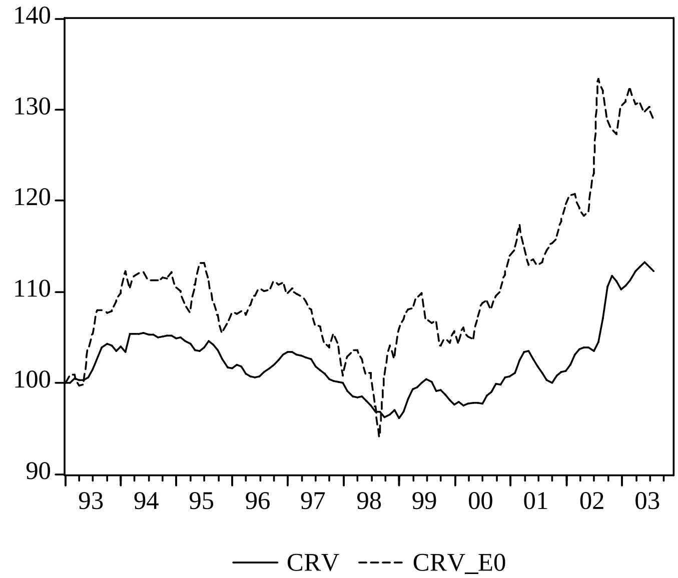
B. Unadjusted Annuity Rates (TV)



Note: *Estimated equation:* $\Delta TV_t = a + \rho \Delta TV_{t-1} + b_1 \Delta PRC20_{t-1} + b_2 \Delta PRC20_{t-2} + \omega_t$. *The figure shows rolling estimations of* $(b_1 + b_2)/(1-\rho)$, *p-values of the restriction* $(b_1 + b_2) = 0$ *(P1) and of the restriction* $(b_1 + b_2) = (1-\rho)$ *(P2)*

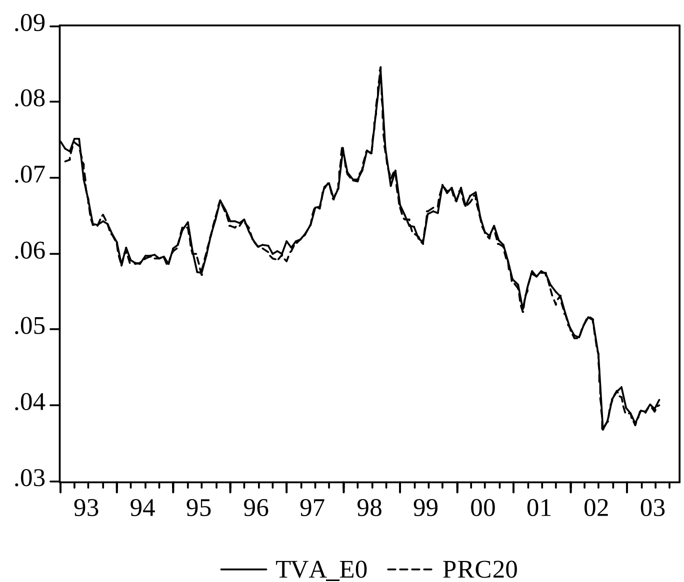
Figure 5: Estimated Monthly Annuity Cost and Internal Rates of Return

A. Estimated Monthly Annuity Cost



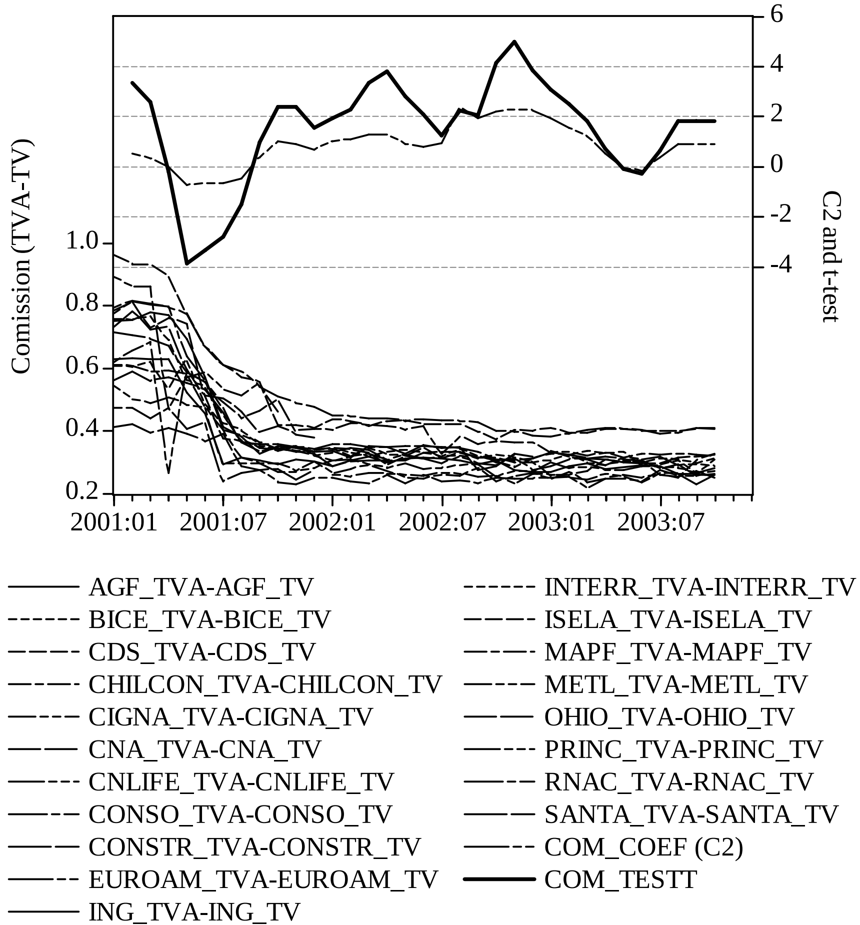
Note: *Calculations of the indexes representing the cost of an annuity are based on the full term structure of interest rates (CRV_E0) and on the effective interest rates paid by LICOs (CRV).*

B. IRR of the Estimated Annuity Cost (TVA_E0) versus PRC20



Note: *Internal rates of return of the annuity cost for LICOs estimated using the full term structure of interest rates (TVA_E0) versus the long term risk free rate.*

Figure 6: Relationship between Adjusted Annuity Rates and Commissions



Note: Moving Quartlerly Panel Regression of the equation $TVA_{it} = c_0+c_1p_{it}+c_2(TVA_{it}-TV_{it})$. The acronym before the symbol "_" represents a specific life insurance company. In each case the difference between "adjusted" (TVA) and unadjusted (TV) annuity rates is plotted. "COM_COEFF" and "COM_TESTT" represent the regression slope coefficient (c_2) and the corresponding t-test, respectively.

Table 1: Annual Averages and Descriptive Statistics

A. Annual Averages (percent)

Year	*Annuity rate - TV (1)*	*Commission (1)*	*Adjusted annuity rate - TVA*	*PRC20 (2)*
1993	5.17	4.26	5.74	6.83
1994	4.77	4.26	5.33	5.93
1995	4.84	4.84	5.48	6.20
1996	5.10	4.98	5.77	6.17
1997	5.01	5.33	5.72	6.45
1998	5.56	5.28	6.29	7.32
1999	5.33	5.95	6.15	6.54
2000	5.37	5.90	6.19	6.42
2001	5.24	3.94	5.77	5.53
2002	4.93	2.67	5.28	4.56
2003[a]	4.18	2.70	4.51	3.91
Average	5.07	4.61	5.56	6.05

a.Until August.

Sources: (1) Superintendencia de Valores y Seguros; (2) Bolsa de Comercio de Santiago.

B. Descriptive Statistics

Statistic	*PRC20*	*TVA*	*TVA-PRC20(-2)*	*TVA-TV*
Mean	0.060256	0.056862	-0.003916	0.006229
Median	0.061400	0.057390	-0.004960	0.006664
Maximum	0.084600	0.065279	0.010017	0.008786
Minimum	0.036700	0.043670	-0.019999	0.003266
Standard deviation	0.009409	0.004881	0.005597	0.001623
Skewness	-0.790931	-0.790634	0.222732	-0.560318
Kurtosis	3.631803	3.578910	3.054669	2.217609
Jarque-Bera	15.11179	14.76848	1.049101	9.728959
Probability	0.000523	0.000621	0.591821	0.007716
Sum	7.532000	7.107753	-0.489547	0.778576
Sum of squared deviations	0.010979	0.002954	0.003884	0.000326
Observations	125	125	125	125

Note: TV corresponds to the internal rate of return obtained by the annuitant. TVA is the adjusted annuity rate paid by the insurance companies, which deducts broker commissions from the premium. Both rates are estimates using the RV85 mortality table for a 65-year-old male with no descendants. PRC20 is the interest rate of an indexed central bank annuity-type bond.

Table 2: Empirical Duration and Convexity of Annuities, Long-Term Interest Rates and Causality Tests

A. Annuity Duration and Convexity

Dependent variable: DLOG(CRV)		
Variable	*Coefficient*	*t-statistic*
D(TVA)	–10.009	–1610.78
D(TVA)*TVA(-1)	44.042	411.10
D(TVA)^2	21.950	69.919
C	8.98E-09	0.0196

B. Duration and Convexity of a Total Return (index of investing in PRC20)

Dependent variable DLOG(IPRC20)		
Variable	Coefficient	t-statistic
D(PRC20)	–9.7152	–71.321
D(PRC20)*(PRC20(-1))	32.047	15.668
D(PRC20)^2	27.597	5.7995
C	0.0048	70.483

C. Granger Causality

Sample: 1993:01 2003:12			
Hypotheses	*Obs*	*F-Statistic*	*Probability*
PRC20 n.c. TVA (Lags: 3)	124	34.9951	3.2E-16
TVA n.c. PRC20		0.40836	0.74728
D(PRC20) n.c. D(TVA) (Lags: 2)	123	49.0612	2.9E-16
D(TVA) n.c. D(PRC20)		0.41652	0.42634

Note: TVA corresponds to the “adjusted” annuity rate using the RV85 mortality table for a 65-year-old male pensioner with no beneficiaries. Adjusted rates correspond to the effective internal rate of return paid by life insurance companies, which excludes from the premium paid by the annuitant the commissions paid to the brokers. PRC20 corresponds to the Central Bank long-term indexed interest rate.

Table 3: Long-Term Elasticity Estimation

A. Relationship between Interest Rate Changes

Dependent variable: D(TVA)				
Sample 1993:05 2003:08				
Observations: 124				
Variable	*Coefficient*	*Standard error*	*t-statistic*	*Probability*
D(TVA(-1)) (ρ)	0.3452	0.0657	5.2542	0,0000
D(PRC20(-1)) (b_1)	0.1599	0.0218	7.3078	0,0000
D(PRC20(-2)) (b_2)	0.1449	0.0245	5.9108	0.0000
CONSTANT (a)	0.0000	5.28E-05	0.0828	0,9341
R-squared	0.5922	Average Dependent Variable		–0.000118
Adjusted R-squared	0.5820	Standard deviation of dependent variable		0.000895
Regression standard error	0.0005	Akaike information criterion		–12.04
Sum squared residuals	4.01E-05	Schwarz criterion		–11.95
Log likelihood	750.56	F-statistic		58.10
Durbin-Watson	2.1469	Probability(F-statistic)		0.0000

Note: Results of estimating $\Delta TVA_t = a + \rho\Delta TVA_{t-1} + b_1\Delta PRC20_{t-1} + b_2\Delta PRC20_{t-2} + \omega_t$. TVA corresponds to the "adjusted" annuity rate using the RV85 mortality table for a 65-year-old male pensioner with no beneficiaries. Adjusted rates correspond to the effective internal rate of return paid by life insurance companies, which excludes from the premium paid by the annuitant the commissions paid to the brokers. PRC20 corresponds to the Central Bank long-term indexed interest rate.

B. Hypotheses

	$b_1+b_2 = 0$		
Test statistic	*Value*	*DF*	*Probability*
F-statistic	97.235	(1. 120)	0.0000
Chi-square	97.235	1	0.0000

	$b_1+b_2 = 1-\rho$		
Test statistic	*Value*	*DF*	*Probability*
F-statistic	30.212	(1. 120)	0.0000
Chi-square	30.212	1	0.0000

Table 4: Long-Term Elasticity versus Interest Rate and Commission Levels

Dependent variable: LOG(LT_ELAST)				
Method: Generalized Method of Moments				
Sample: 1995:02 2003:08				
Observations: 103				
Variance-covariance adjusted using a Bartlett kernel with fixed bandwidth (4), no prewhitening				
Simultaneous weighting matrix and coefficient iteration				
Instruments: PRC20(-2) TVA-TV C				
Variable	*Coefficient*	*Standard error*	*t-statistic*	*Probability*
PRC20(-2)	–9.5417	6.0331	–1.5815	0.1169
TVA-TV	–154.47	30.911	–4.9972	0.0000
C	0.6744	0.2191	3.0773	0.0027
R-squared	0.7288	Average Dependent Variable		–0.8796
Adjusted R-squared	0.7234	Standard deviation of dependent variable		0.4132
Regression standard error	0.2172	Sum squared residuals		4.7216
Durbin-Watson	0.2953	J-statistic		4.15E-29

Note: Results from regressing the rolling coefficient $(b_1+b_2)/(1-\rho)$ against long-term interest rates and commissions. TVA (TV) corresponds to the "(un)adjusted" annuity rate using the RV85 mortality table for a 65-year-old male pensioner with no beneficiaries. Adjusted rates correspond to the effective internal rate of return paid by life insurance companies, which excludes from the premium paid by the annuitant the commissions paid to the brokers. PRC20 corresponds to the Central Bank long-term indexed interest rate. Unadjusted rates correspond to the internal rate of return received by the pensioners.

Table 5: Adjusted Annuity Rates versus Commissions (Panel Regressions)

Simple period: 2001:1 - 2003:10 (34 months)
Different LICOs: 21
Total number of obs. (unbalanced panel): 553

A. Explanatory Variable: Broker Commission (X=C)

	Regression Type			
	Simple*	Lagged Dependent*	Fixed Effects*	Random Effects
Constant	0.7888	0.2103		0.7713
t-test	*20.5494*	*5.5699*		*13.8779*
Comission (*C*)	–0.1429	–0.0304	–0.1810	–0.1778
t-test	*–18.2339*	*–3.6939*	*–25.1292*	*–22.2234*
Market share (*p*)	–0.0797	0.2547	2.4068	2.1209
t-test	*–0.3564*	*1.4179*	*7.9998*	*6.7970*
TVA_{it-1}-$PRC20_{t-3}$		0.6670		
t-test		*22.977*		
R-squared	0.3197	0.6318	0.5990	0.5976
Adj. R-squared	0.3172	0.6297	0.5823	0.5962
Regression standard error	0.2600	0.1797	0.2033	0.1999
Log likelihood	–38.1528	160.1250	107.9990	
Durbin-Watson	0.6531	2.0471	1.0969	1.0846
Avg. Dep. Var.	0.3019	0.3241	0.3019	0.3019
Std. Dev. Dep. Var.	0.3146	0.2954	0.3146	0.3146
Sum of Squared Resids.	37.1687	16.3587	21.9088	21.9821
F Statistic.	129.2222	40.4762	35.9848	
Prob(F-statistic)	0.0000	0.0000	0.0000	

B. Explanatory Variable: X=TVA-TV

	Regression Type			
Variable	Simple*	Lagged Dependent*	Fixed Effects*	Random Effects
Constant	0.7816	0.2110		0.7604
t-test	*21.0700*	5.6590		*13.9642*
Commission (*TVA-TV*)	–1.2117	–0.2608	–1.5346	–1.5098
t-test	*–18.8536*	*–3.7694*	*–25.8782*	*–23.6732*
Market share (*p*)	–0.1224	0.2472	2.3835	2.1123
t-test	*–0.5615*	1.3745	*8.1120*	*6.9687*
TVA_{it-1}-$PRC20_{t-3}$		0.6620		
t-test		*22.396*		
R-squared	0.3385	0.6321	0.6236	0.6224
Adj. R-squared	0.3361	0.6301	0.6080	0.6210
Regression Standard Error	0.2563	0.1796	0.1970	0.1937
Log likelihood	–30.3765	160.40	125.5211	
Durbin-Watson	0.6735	2.0423	1.1618	1.1504
Avg. Dep. Var.	0.3019	0.3241	0.3019	0.3019
Std. Dev. Dep. Var.	0.3146	0.2954	0.3146	0.3146
Sum of Squared Resids.	36.1379	17.043	20.5635	20.6296
F Statistic.	140.7520	302.51	39.9151	
Prob(F-statistic)	0.0000	0.0000	0.0000	

*Variance-covariance matrix adjusted by heteroskedasticity and autocorrelation using White

Note: results of estimating the equation $TVA_{it} - PRC20_{t-2} = c_{o(i)} + c_1 p_{it} + c_2 X_{it} + u_{it}$ with two specifications for *X*: broker commission as percentage of the insurance premium and expressed as the difference between adjusted and unadjusted annuity rates. TVA (TV) corresponds to the "(un)adjusted" annuity rate using the RV85 mortality table for a 65-year-old male pensioner with no beneficiaries. Adjusted rates correspond to the effective internal rate of return paid by life insurance companies, which excludes from the premium paid by the annuitant the commissions paid to the brokers. PRC20 corresponds to the Central Bank long-term indexed interest rate. Unadjusted rates correspond to the internal rate of return received by the pensioners.